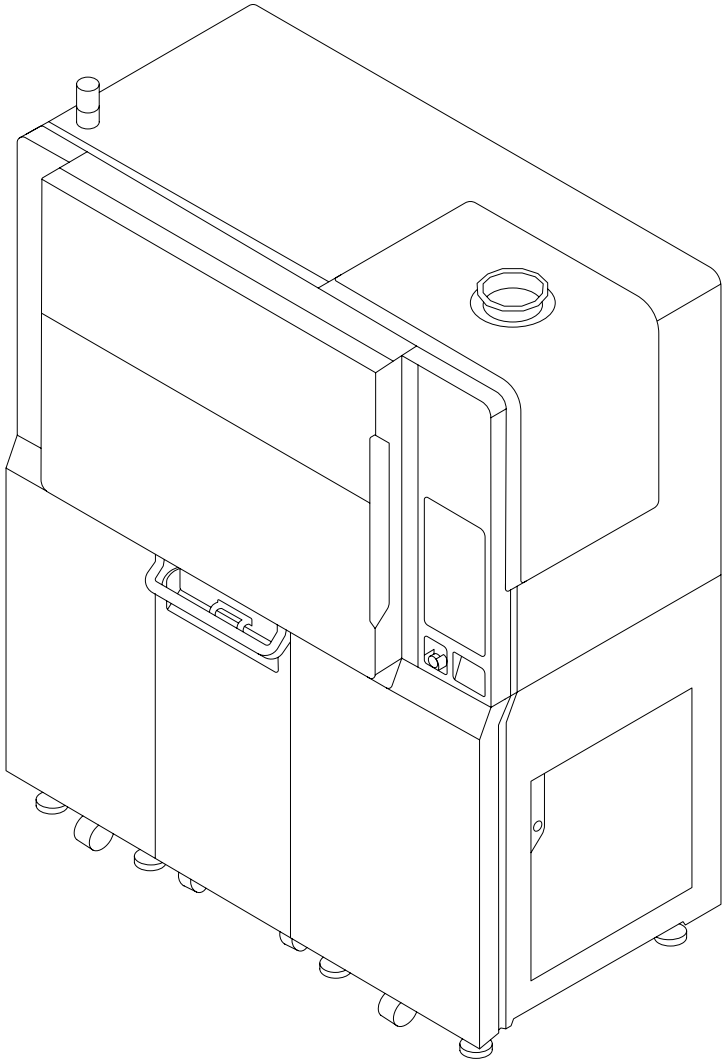
Manual | Fuse X1



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Installation and Usage Instructions

Fuse X1

Selective Laser Sintering (SLS) 3D Printer

Original English instructions
Read this manual carefully and keep it for future reference.
June 2026
REV 01

formlabs

1 Table of Contents

WARNING

Read and understand this manual and its safety instructions before using the Fuse X1. Failure to do so can result in serious injury or death.

DISCLAIMER

Formlabs has made every effort to make these instructions as clear, complete, and correct as possible. The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation, and testing of the products with respect to the relevant specific application or use thereof. Neither Formlabs nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information that is contained herein. Notify us if you have any suggestions for improvements or amendments or have found errors in this publication.

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TRADEMARKS

DOCUMENT REVISIONS

Date	Version	Document changes
June 2026	REV 01	Initial publication

1 Preface

Congratulations on purchasing the Fuse X1. On behalf of the Formlabs team, we thank you for your purchase. The Fuse X1 is a Selective Laser Sintering (SLS) 3D printer.

The Fuse X1 fabricates large, high-quality, self-supported thermoplastic parts, by heating powdered thermoplastic to just below the melting point, then sintering the part in layers (2D cross sections) using a Ytterbium fiber laser. The sintered layers are stepped down, and the 3D part is constructed by sequentially stacking sintered cross sections. The Fuse X1 offers industrial power in an accessible package, with unmatched cost-per-part and exceptional ease-of-use.

This manual explains how to set up, use, and properly maintain the Fuse X1, as well as providing workflow and design guidance for optimizing print results. This manual is intended for anyone who is installing, operating, maintaining, or otherwise interacting with the Fuse X1. Supervise young or inexperienced users to ensure enjoyable and safe operation.

1.1 Read and retain instructions

Read and understand this manual and its safety instructions before using the Fuse X1. Failure to do so can result in serious injury or death. Keep all safety information and instructions for future reference and provide them to subsequent users of the product.Follow all instructions to avoid fire, explosions, electric shocks, or other hazards that may result in damage to property and/or severe or fatal injuries. The Fuse X1 shall only be used by persons who have fully read and understand the contents of this manual. Ensure that each person who uses the Fuse X1 has read these warnings and instructions and follows them. Formlabs is not liable for cases of material damage or personal injury caused by incorrect handling or non-compliance with the safety instructions. In such cases, the warranty will be voided.

1.2 Obtaining documentation and information

Visit formlabs.com to:

- Access your **Formlabs store** (**formlabs.com/store**) and **Dashboard** accounts (**formlabs.com/dashboard**).
- Find **certified service providers** in your region (**formlabs.com/company/partners**).
- Access the **Terms of Service** (**formlabs.com/terms-of-service**) and the **Privacy Policy** (**formlabs.com/privacy-policy**).

Visit **support.formlabs.com** to:

- Access the latest version of all Formlabs product documentation.
- Contact Formlabs Support to request documentation, manuals, repair guides, and technical information.
- Submit any comments or feedback regarding what is good and what can be improved. Formlabs values comments from its users.
- Request additional training.

1.2.1 Support and service

Retain a record of the original purchase to request warranty services. Service options depend on the status of the specific product's warranty. Include the serial name of the product when contacting Formlabs Support or a certified service provider for product support. Instead of

a serial number, Formlabs products have a serial name, which is a unique identifier to track the history of manufacturing, sales, and repair, and to distinguish usage when connected to a network. The serial name is on the back panel of the machine in the format **AdjectiveAnimal**.
Service providers of Formlabs products also provide support and service. To the extent that Formlabs or a certified service provider offers other or extended warranties, the terms of the separate offer may apply.
For products purchased from certified service providers, contact the original service provider for assistance before contacting Formlabs Support.
For any support or service requests, including product information, technical assistance, or assistance with instructions, contact Formlabs Support:

support.formlabs.com	**USA** Formlabs, Inc. 35 Medford St. Somerville, MA, USA, 02143	**USA** Formlabs, Inc. 220 E Buffalo St. Milwaukee, WI, USA 53202
Germany Formlabs GmbH Mühlenstr. 15 10243 Berlin, Germany	**Hungary** Formlabs Andrássy út 9 1061 Budapest, Hungary	**Japan** 1F Kitashinagawa Ubiz Shinagawa 3 Chome-6-9 Kitashinagawa Shinagawa City Tokyo 140-0001, Japan

1.2.2 Warranty

This product is protected under warranty. Formlabs offers a warranty for all Formlabs branded hardware. Unless otherwise expressly stated, the **Terms of Service**, including the **Warranty**, constitute the entire agreement between you and Formlabs with respect to the **Service** and any product you purchase from Formlabs and supersedes all prior or contemporaneous communications, proposals, and agreements, whether electronic, oral, or written, between you and Formlabs.
Read the warranty for more details on the Formlabs warranty for your region:

US	**formlabs.com/support/terms-of-service**
EU (EN)	**formlabs.com/eu/terms-of-service**
EU (DE)	**formlabs.com/de/support/terms-of-service/eu**
EU (FR)	**formlabs.com/fr/support/terms-of-service/eu**
EU (ES)	**formlabs.com/es/terms-of-service/eu**
EU (IT)	**formlabs.com/it/terms-of-service/eu**
Latin America (ES)	**formlabs.com/latam/terms-of-service/**
Asia and Oceania (EN)	**formlabs.com/asia/terms-of-service/**
Japan (JA)	**formlabs.com/jp/terms-of-service/**

2 Introduction

2.1 Intended use

The Fuse X1 is a commercial, precision tool intended for use in the additive manufacture of end-user supplied designs from SLS powder. The final performance characteristics of sintered SLS powder may vary according to your compliance with the instructions for use, application, operating conditions, material combined with, end use, or other factors.

In some cases, the additive manufacturing process may inherently result in variable performance characteristics between manufacturing runs or within a specific part. Such variances may not be apparent and may result in unexpected defects in additively fabricated parts.

WARNING

You shall independently verify the suitability of additive manufacturing, Selective Laser Sintering (SLS), the Fuse X1, and any specific designs or materials employed for the application and intended purpose before use. In no event shall Formlabs be liable for any loss, death, or bodily injury that you suffer, or that you cause to any third party, in connection with your use of Formlabs products. To the fullest extent legally permitted Formlabs EXPRESSLY DISCLAIMS ANY IMPLIED OR EXPLICIT WARRANTY OF FITNESS for a particular usage, the particular nature and circumstances of said usage being unforeseen and unforeseeable to Formlabs.

WARNING

Formlabs is not a manufacturer of medical devices. Formlabs provides tools and materials that may be used in many applications, but makes no claims as to the safety or effectiveness of any specific devices made using Formlabs products. Certain Formlabs products, such as those commonly known in the industry as “biocompatible” materials, have been engineered to comply with relevant industry standards. The specific standards and most relevant technical specifications may be identified within the technical data sheets and have been tested according to relevant testing protocols for those standards and specifications. Biocompatible materials are a speciality product, developed for use by medical professionals, and should be used in accordance with the instructions for use.

WARNING

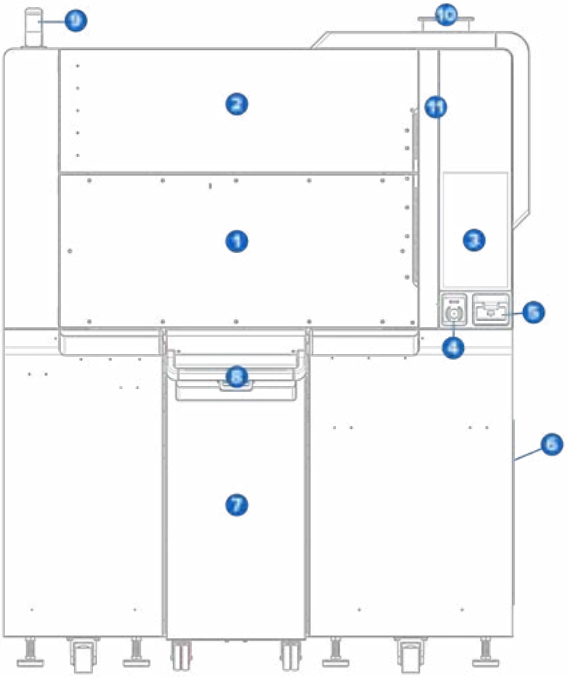
Do not modify. The Fuse X1 is intended for use as-is. Modifying the machine without explicit approval and directions from Formlabs or a certified service provider will void your warranty, and could potentially ruin the machine and cause you bodily harm.

2.2 Technical specifications

Parameter	Unit
Printer	Fuse X1
Minimum dimensions for convenient access (W × D × H)	241 × 193 × 241 cm | 94.8 × 75.9 × 95.1 in Space includes 1.1 m in front and 0.4 m on the sides for door and panel access. Place the printer at least 20.0 cm (8.0 in) from nearby walls

Parameter	Unit
Printer dimensions (W × D × H)	157 × 83 × 193 cm | 62.1 × 31.3 × 75.8 in
Printer weight	570 kg | 1256 lb (without build unit or powder) 1685 lbs | 766 kg (full hopper and full build unit at 25% packing density)
Build unit dimensions (W × D × H)	42 × 68 × 102 cm | 16.4 × 26.9 × 40.2 in
Build unit weight	86.6 kg (129 kg when full, 20% packing density) 191 lb (283 lbs when full, 20% packing density)
Build volume (W × D × H)	330 × 330 × 565 mm | 13 × 13 × 22.2 in
Build volume	61.5 L
Material refresh rate	Up to 80% recycled powder
Hopper capacity	14.5 L powder
Operating environment	18–28 °C | 68–82 °F RH < 30%
Maximum operating temperature in print chamber	210 °C | 410 °F
Temperature control	Quartz tube heating elements, resistive heaters
Air handling	Pressure-controlled filtration (replaceable HEPA)
Atmosphere control modes	Air Mode: the print enclosure atmosphere is composed of atmospheric air Nitrogen Mode: the print enclosure is purged with a supply of nitrogen gas
Nitrogen intake requirements	Purity: >99.5% Nitrogen line fittings: ⅜ NPT (printer-side connector) Pressure: >50 PSI, internally regulated to 50 PSI. Continuous flow rate: 0.8 SCFM (22.65 L/min) minimum Gas temperature at machine inlet: minimum 18 °C
Power requirements	200–240 VAC single phase, 50/60Hz, 50 A rated circuit 3.5 kW typ., 7.5 kW max (at 208 VAC) Separate 120 VAC outlet for Fuse X1 Vacuum Conveyor Separate outlet for Fuse X1 Mix Kit
Laser specifications	EN 60825-1: 2014 Class 1 laser product Emission wavelength : 1064 nm Driven at maximum 120 W 2.5–3.5 mrad beam divergence (nominal, full angle)
Laser spot size	330 µm (FWHM), 560 µm (1/e2)
Galvo speed	35 m/s
Radiation information	The Fuse X1 is a class 1 laser product. Accessible radiation is within class 1 limits.
Network connectivity	**Wi-Fi:** Via dongle connected to USB A port **Ethernet:** 1000 Mbit
Ethernet connectivity	RJ-45 Ethernet (10BASE-T/100BASE-TX/1000BASE-T) LAN port Connect with a shielded Ethernet cable (not included): minimum Cat5, or Cat5e or Cat6 for 1000BASE-T.
USB connectivity	USB A port (rear panel): used for Wi-Fi dongle (optional) USB B port (rear panel): used for firmware updates via PreForm (optional) USB (rev 3.0) C port (front panel): used for job uploads via USB mass storage (planned feature)
Printer control	Interactive touchscreen
Powder dispensing system	Automated
Powder hopper filling	Automated, with included Fuse X1 vacuum conveyor
Alerts	Touchscreen alerts, stack light indicator
Print preparation	PreForm desktop software

2.3 Product components



2.3.1 Fuse X1

2.3.1.1 Front

1. **Print chamber access door**
2. **Maintenance access door:** Optics, IR sensor, and related filters
3. **User interface (touchscreen)**
4. **E-stop**
5. **Powder card slot**
6. **Filter access door**
7. **Fuse X1 Build Unit**
8. **Build unit handle**
9. **Stack light indicator**
   - Solid green: job running
   - Flashing green: print complete
   - Solid yellow: alert while printer idle
   - Flashing yellow: alert while job is running
   - Solid red: error
10. **Hopper inlet**
11. **Hopper level indicator window**

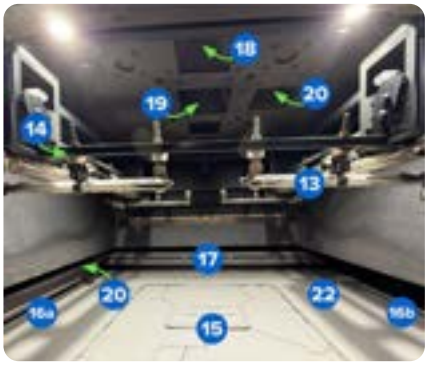
Rear (not pictured): intake filters

2.3.1.2 Vacuum Conveyor (Mounted)

12 **Fuse X1 Vacuum Conveyor**

2.3.1.3 Print chamber

13 **Quartz tube heater (8x)**
14 **Quartz tube mount**
15 **Print bed**
16 **(a) Buffer-side trough (left) (b) Hopper-side trough (right)**
17 **Recoater rack**
18 **Visible camera window and purge housing**
19 **Laser window and purge housing**
20 **IR camera window and purge housing**
21 **Recoater (in left position)**
22 **Build sheet**
Overhead lights (not numbered)



2.3.1.4 Rear panel

23 **Communication ports (USB A, Ethernet, USB B)**
24 **Power switch**
25 **Power connection (wired during installation)**

2.3.2 **Fuse X1 Build Unit**

1 **Build unit latch**
2 **Build unit handle**
3 **Gasket**
4 **Wheels**
5 **Print bed (lowered)**

2.3.3 Additional Fuse X1 package components

1. **Bubble level:** For leveling the printer during installation.
2. **Leveling wrench:** For leveling the printer during installation.
3. **8 mm hex key:** For opening printer access doors.
4. **Flexible tube brush:** Long flexible brush for cleaning internal components of the Fuse X1.
5. **Push-top dispensers:** For dispensing Alconox, distilled water, and ethanol to clean printer components.
6. **Polyester swabs:** For cleaning the upper laser window, the IR sensor and the IR sensor housing.
7. **Optical microfiber cleaning cloths:** For cleaning the printer's optical components.
8. **Telescoping mirror:** For inspecting the components within the print chamber.

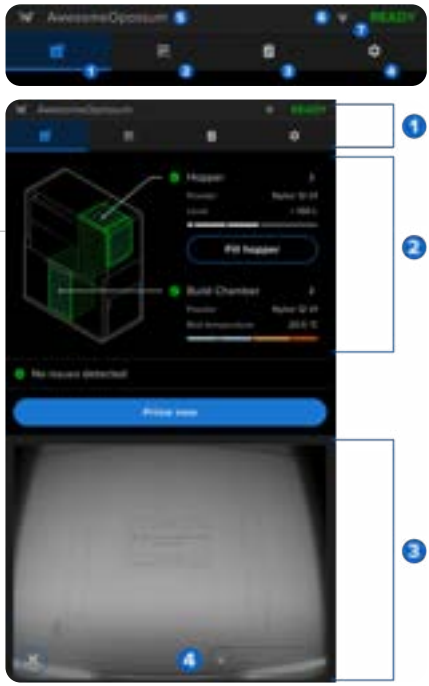
2.4 Fuse X1 user interface

The Fuse X1 is controlled through a touchscreen interface on the right-hand side of the machine. The interface is split into an information pane and camera pane. The information pane can be navigated using the the navigation bar, labeled below:

1. **Printer status**
2. **Print queue**
3. **Maintenance**
4. **Settings**
5. **Serial name**
6. **Connection status**
7. **Status indicator**

2.4.3.1 Interface

1. **Navigation bar**
2. **Information pane**
3. **Camera pane**
4. **Print chamber access door unlock slider**



3 Safety

Read and understand this manual and its safety instructions before using the Fuse X1. Failure to do so can result in serious injury or death.

Supervise young or inexperienced users to ensure enjoyable and safe operation.
The instructions contain warnings and safety information, as explained below:

DANGER indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

WARNING indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.

CAUTION indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

NOTICE indicates information considered important, but not hazard-related.

DANGER: Ethanol is a flammable chemical.

DANGER: CLASS 4 INVISIBLE LASER RADIATION WHEN OPEN AND INTERLOCKS DEFEATED AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION

WARNING: Class 1 laser product. Only remove the exterior paneling of the printer with authorization from Formlabs Support or a certified service provider.

ENVIRONMENTAL HAZARD: Unsintered SLS powder is classified as a microplastic, a group of plastics that are hazardous to aquatic life..

MANDATORY ACTION: Refer to instruction manual/booklet.

MANDATORY ACTION: Wear a respirator (N95 or better).

MANDATORY ACTION: Wear thermal-insulating silicone gloves when handling hot build chambers.

MANDATORY ACTION: Disconnect before carrying out maintenance or repair.

MANDATORY ACTION: Grounding required.

3.1 Component and subsystem safety

3.1.1 General

DANGER

The Fuse X1 requires a 200–240 VAC (50/60 Hz), 50 A power supply for nominal operation. Unless explicitly instructed by **Formlabs Support** or a **certified service provider**, do not disassemble or tamper with the product beyond what is explicitly outlined for typical maintenance. Tampering with, or disassembling the Fuse X1 prior to disconnecting the power supply and waiting approximately ten minutes can subject users to potentially fatal electrical hazards.

WARNING

The print chamber in Fuse X1 series printers is designed to operate at up to 210 °C (410 °F). Failure to follow these procedures will result in serious injuries, including burning and/or scalding of skin.

CAUTION

Due to its size and weight, do not move or reposition the Fuse X1 alone. If the machine needs to be moved, work with at least one other individual.

NOTICE

Do not lift or reposition the Fuse X1:

- By grabbing or pulling on the print chamber door, filter compartment, filter door, power cable, or any components inside the print chamber.
- By pushing on any side of the unit while stationary.
- When the build unit from a previous print is loaded or still cooling in the printer.
- When the print chamber is still hot from a previous print..

NOTICE

The Fuse X1 requires an operating environment that is low in ambient humidity and static electricity. Due to the sensitive nature of its components and the printing mediums, system reliability and print quality may fluctuate if the ambient temperature and moisture are outside the recommended ranges. Refer to section **4.1 Location and environment** for the recommended operating environs. When performing maintenance or testing with the exterior paneling of the machine removed, ground equipment to the grounding stud marked with this protective earth symbol.

3.1.2 Laser

The above Class 4 laser warning label is also located in the Fuse X1. It can be seen on the laser module heatsink. It is visible when the rear cover of the printer is opened by an authorized technician.

WARNING

Class 1 laser product. The laser beam is extremely harmful to the eyes and skin, capable of causing permanent blindness. Avoid direct contact at all times. The Fuse X1 contains redundant interlock systems to automatically shut off the laser when the print chamber door is open, or if the IR sensor is out of place. If these systems are tampered with or fail, there is a risk of exposure to Class 4 laser light. Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure. Only remove the exterior paneling of the machine with authorization from **Formlabs Support** or a **certified service provider**.

Accessible radiation is within Class 1 limits. The laser diode used inside the device has the following specifications:

- Class 1 laser product
- Emission wavelength : 1064 nm
- Driven at maximum 120 W
- 2.5-3.5 mrad beam divergence (nominal, full angle)

3.1.3 Vacuum

NOTICE

Typical Fuse X1 and Fuse Sift X1 operation involves the use of a compliant vacuum that is grounded and bonded, such as a Class II, Division 2 vacuum, which typically utilizes disposable bags for collecting debris. Formlabs recommends that operators regularly check the accumulation of debris inside the vacuum's collection chamber.

3.1.4 Powder

WARNING

Dry powders can build static electricity charges when subjected to the friction of transfer and mixing operations. Therefore: avoid dust generation and dispersal of dust in air; dust deposits should not be allowed to accumulate on surfaces; clean dust residues at regular intervals; do not use brooms or compressed air hoses to clean surfaces; only use vacuums approved for dust collection that are grounded; use only non-sparking tools; keep powder containers tightly closed when not in use.

NOTICE

Consult the safety data sheet (SDS) as the primary source of information to understand safety and handling of Formlabs powders. Respect Formlabs powder like any household chemical. Follow standard chemical safety procedures and Formlabs powder handling instructions. In general, Formlabs powder is not approved for use with food, drink, or medical applications on the human body. Refer to the safety data sheet (SDS) for each specific powder as well as support.formlabs.com for more detail.

3.1.5 Radio interference

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their own expense.

Changes or modifications to this product not authorized by Formlabs could void the electromagnetic compatibility (EMC) and wireless compliance and negate your authority to operate the product.

This product has demonstrated EMC compliance under conditions that included the use of compliant peripheral devices and shielded cables between system components. It is important that you use compliant peripheral devices and shielded cables between system components to reduce the possibility of causing interference to radios, televisions, and other electronic devices.

3.1.6 Ethanol

Ethanol is a flammable chemical. Keep away from ignition sources, including open flames, sparks or concentrated sources of heat.

Formlabs does not manufacture ethanol. Consult the chemical manufacturer or supplier for detailed safety information. Carefully follow the safety instructions provided with the ethanol that you purchase. Ethanol can be flammable, even explosive, and should be kept away from heat, fire, or sparks. Any containers holding ethanol should be kept closed or covered when not in use. We also recommend that you wear protective gloves and have good ventilation when working with ethanol.

3.1.7 Nitrogen

The Fuse X1 prints with nitrogen as an inert gas atmosphere in the print chamber. The inert nitrogen atmosphere prevents the oxidation of plastic powder. The nitrogen gas is used to displace oxygen in the air. If nitrogen gas displaces the existing oxygen content of ~21% in the room containing the Fuse X1, a significant hazardous situation may be created. Install an oxygen monitor with an alarm located in the same room as the Fuse X1 if you plan to use a nitrogen supply to print with an inert gas atmosphere in the print chamber.

The United States Occupational Safety and Health Administration states that “atmosphere with an oxygen level below 19.5 percent to be oxygen-deficient and immediately dangerous to life or health” (source). If a room containing a Fuse X1 or

or its nitrogen supply is found to have an oxygen level below 19.5%, the room must be exited immediately. Preventative and corrective actions must be taken in a safe manner that does not risk exposing any individual to an oxygen deficient environment. Exposure to oxygen deficient environments can lead to unconsciousness or death.

3.2 Personal protective equipment (PPE)

Refer to the relevant material SDS for recommended protective measures.

3.3 Specification of tools to be used

The Fuse X1 shall only be used with supplied accessories and additional tools recommended by Formlabs or a certified service provider. Third-party accessories and materials may cause damage. Refer to sections **3.2 Personal protective equipment (PPE)** and **6.1 Tools and supplies for more information.**

Purchase additional supplies:

- **Compliant vacuum (e.g., NFPA 652)**
  Certified for use with materials whose fine particles present an explosive risk when in the vicinity of potentially malfunctioning electrical equipment.
- **Ethanol (laboratory-grade)**
  Cleaning agent used for various printer components.
- **Alconox**
  Cleaning agent used for various printer components.
- **Distilled water**
  Cleaning agent used for various printer components.
- **Optical microfiber cleaning cloths**
  Disposable lint-free, non-woven microfiber cloths for cleaning the printer's optical components. Do not reuse a cloth; dispose of it after each use, even when cleaning printer components with the same cleaning agent. Cloths are available for purchase on the Formlabs Store.
- **Polyester cloth swabs**
  Disposable lint-free polyester cloth swabs with either orange or blue plastic handles for cleaning the IR sensor and camera lens. Do not reuse a polyester swab—dispose after each use.

3.4 Sensitive components

The Fuse X1 has multiple components that are vulnerable to permanent damage if not periodically inspected and properly maintained. Using any tools, cleaning agents, or methods not mentioned in this manual may result in permanent damage to these components. Follow the maintenance instructions outlined in this manual, pre-print checkpoints on the touchscreen when starting a print, and on **support.formlabs.com** when servicing the following components or any other internal component of the printer.

- **IR sensor**
  The Fuse X1 uses an infrared (IR) sensor to monitor conditions inside the print chamber and as a secondary interlock measure for the laser. Refer to maintenance section **6.33 Cleaning the IR sensor and purge housing** for more information.

- **Optical windows**
  There are two individual optical windows contained in the ceiling of the printer, both of which need to be cleaned regularly. They protect the camera and upper laser window. Refer to maintenance sections **6.3.2 Cleaning the lower laser window** and **6.3.4 Cleaning the camera window and purge housing** for more information.
- **Upper laser window**
  The upper laser window encloses the laser's aperture and galvo-driven mirrors to prevent detrimental accumulation of laurolactam. While the upper laser window is protected by the lower laser window, it may be necessary to inspect and clean it if explicitly instructed to do so by Formlabs or a certified service provider.

3.5 Emergency and exceptional situations

Formlabs has made every effort to provide updated safety data sheets (SDS) for every powder product, in accordance with the latest government guidelines. Always consult the safety data sheet (SDS) as the primary source of information to understand safety and handling of Formlabs materials and required accessories.

3.5.1 Fire

Do not use water to extinguish an electrical fire. Dousing an electrical fire with water increases the risk of electrocution, and may cause the fire to spread by allowing electricity to conduct across additional flammable surfaces.

If a localized fire develops either inside or outside of the machine, immediately take the following actions.

If the fire is inside the print chamber:

1. Immediately disconnect the machine from its power source.
2. If it is safe to do so, remove the build unit from the printer.
3. Use an ABC fire extinguisher to cover the affected area generously.

If the fire is too large to control:

1. Immediately leave the area and close the door of the room behind you.
2. Evacuate the building according to your organization's emergency protocols.
3. Call emergency services once you have reached a safe distance from the fire.

3.5.2 Ethanol

When handling ethanol, always consult the safety data sheet (SDS) from the ethanol supplier as the primary source of information. Handle ethanol with gloves in a well ventilated area. Keep away from heat, sparks, and open flame. Ethanol evaporates rapidly, so keep the rinse tub and bottles closed whenever possible.

3.5.3 Powder

In an emergency involving powder, always refer to the safety data sheet (SDS) and/or seek help from a medical professional.

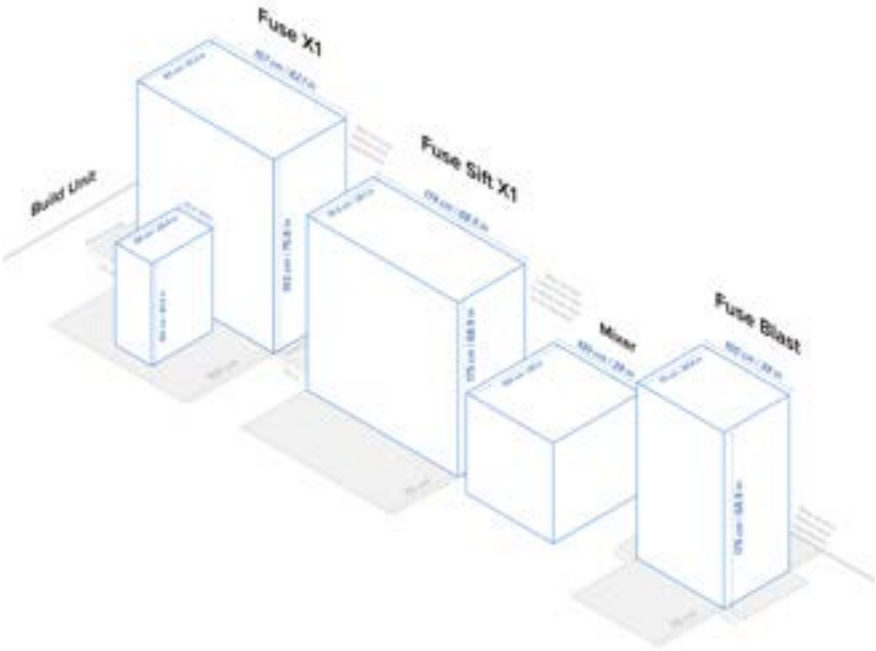
4 Preparation and setup

4.1 Location and environment

Prepare a space to install and operate the Fuse X1 and house the necessary accessories and consumables.

To prepare the workspace:

1. Choose a location separate from any machinery or tooling that generates dust or sparks, such as wood or metal working equipment. Dust can contaminate your powder, while sparks present a safety hazard as unsintered powder is a combustible material.
2. The Fuse X1 and Fuse Sift X1 are free standing components. Reserve the following minimum dimensions for the most convenient access:



- **Fuse X1:**
  - The Fuse X1 footprint is 157 × 83 × 193 cm (62.1 × 31.3 × 75.8 in). Reserve a space at least 241 × 243 × 241 cm (94.8 × 95.8 × 95.1 in) for the machine. Leave at least 1.0 m in front and 0.4 m on the sides for door and panel access. Place the printer at least 20.0 cm (8.0 in) from nearby walls, following any relevant local regulations.
  - Reserve additional space as needed for a nitrogen source (e.g., a nitrogen generator). Place the Fuse 1+ at least 20.0 cm (8.0 in) from nearby walls.

- **Fuse X1 Mix Kit:**
  - Reserve at least 100 × 100 cm (39.4 × 39.4 in) of floor space near your Fuse Sift X1 for the Fuse X1 Mix Kit.
- **Fuse Blast:**
  - The Fuse Blast footprint is 100 × 75 × 175 cm (39 × 29.6 × 68.7 in). With the blasting chamber door open, the Fuse Blast is 195 cm (76.8 in) in height. Leave at least 75 cm (29.5 in) in front of the unit and 22.5 cm (8.9 in) on the sides free for access.
  - Place the Fuse Blast at least 76.2 cm (30 in) from nearby walls.

3. Ensure proper ventilation is installed.
4. Install an oxygen monitor with an alarm located in the same room as the Fuse X1.
5. Purchase additional supplies:

- Antistatic vacuum that is grounded and bonded (e.g., NFPA 652-compliant vacuum)
- Particulate filtering respiratory protection (N95 or better)
- Non-reactive nitrile gloves
- Safety glasses
- Blasting media (200–300 µm for best media filtering performance)
- Air compressor
- Air fittings to connect nitrogen generator, Fuse Sift X1, Fuse Blast, and vacuum conveyors to compressed air supply
- Shielded Ethernet cable (minimum Cat5, or Cat5e or Cat6 for 1000BASE-T)

4.2 Power and networking

4.2.1 Electrical requirements

For detailed guidance and visual assistance, visit **support.formlabs.com**.

The Fuse X1 requires a dedicated single phase AC circuit, rated for 50 A at 200–240 VAC, as well as reliable grounding. This circuit must be separate from other devices, including the corresponding Fuse Sift X1, fans, vacuums, power tools, space heaters, or any large appliances or power tools. Power surges may disrupt prints and/or permanently damage sensitive components, jeopardizing the reliability of the product.

Actual power consumption during a print will depend on environmental conditions, print settings, and print geometry, but will generally be at or below 36 A.

The Fuse X1 has a lockout-capable main disconnect switch located at the rear of the machine. Always disconnect power before performing any electrical maintenance to the machine.

When using a nitrogen generator, which requires a compressed air source, connect the air compressor to a separate electrical circuit from the printer.

4.2.2 Networking

The Fuse X1 has an RJ-45 Ethernet (10BASE-T/100BASE-TX/1000BASE-T) LAN port.

Connect with a shielded Ethernet cable (not included): minimum Cat5, or Cat5e or Cat6 for 1000BASE-T.

For uploading print jobs to the Fuse X1 and remotely monitoring the printer, ensure that the machine maintains a constant connection to a secured network. Refer to section **4.6 Setting up a network connection** for more information.

4.3 Unboxing the machine

The Fuse X1, vacuum conveyor, and build unit are delivered in a single crate on a pallet. Other accessories and devices are packaged separately. The custom packaging the printer arrives in is specially designed to protect the machine during shipping. During unboxing, inspect the product for any damage or missing items. In the case of damage or missing items, contact Formlabs Support or a certified service provider.

CAUTION

Removing the machine from its packaging requires at least two people that are comfortable lifting and moving large and heavy objects.

To unbox the machine:

1. Move the crate near the printer's final installation location. Leave enough space to open and lower the narrow sides of the crate.
2. The right-hand crate panel is hinged at the bottom so it can be lowered to create a ramp. Unscrew the panel and carefully lower it.
3. Remove the vacuum conveyor box and set it aside.
4. Remove the foam on top of and in front of the build unit. Roll the build unit down the ramp and set it aside.
5. Remove the left-hand crate panel and set it aside.
6. Locate the rectangular lifting frame supplied with the printer in the crate.
7. The printer rests on four blocks, one under each corner of the machine. With the help of another person, insert the lifting frame under the left side of the printer and use it as a lever to carefully and slightly lift the machine. Remove the two blocks from under the left side of the printer. Lower the printer onto the crate.
8. Repeat step 7 on the right side of the printer. Once all four corner blocks are removed, the printer should rest on its wheels.
9. With the help of another person, carefully roll the printer down the crate ramp and into its installation location.
10. Remove any additional foam or other packaging from the outside of the printer.

4.4 Installing the machine

Roll the Fuse X1 to its intended installation location. The printer is sized to fit through standard doors without modification.

4.4.1 Connecting the machine to power

The Fuse X1 must be wired to an electrical source at the installation site by a qualified electrician. A portable cord with appropriate plug or hard-wired connection to an appropriate disconnect switch may be used.

To wire the machine, remove the lower-right panel on the back of the machine to access the terminal block, optionally, install a cable gland.

Make wiring connections to the bottom row of three terminals (L1: brown, L2: blue, PE: green/yellow) using appropriate wire and crimp terminals according to local electrical codes. Torque terminal screws to 2–3 N-m (18–26 in-lb).

4.4.2 **Leveling**

The printer must be completely level before the build unit can be inserted and printing can begin. This process does not require power or other utilities, so the printer should be powered off.

Required tools:

- 24 mm open ended or adjustable wrench
- Bubble level
- Tape measure

To level the printer:

1. Use a wrench to loosen the uppermost nut on each of the eight feet to free them from the chassis.

2. Use a wrench to rotate the innermost four feet until they each come into contact with the floor. Do not touch the outermost feet yet.
3. Rotate the four innermost feet incrementally until all four printer wheels are no longer contacting the floor.
4. Using a tape measure, check the height from the floor to the build sheet (item 21 in **2.3 Product components**). It must be 1049 mm. Adjust the innermost feet as needed for the build sheet to sit at this height.
5. Place the bubble level on the build sheet running left-to-right. Adjust the feet accordingly until level in this axis. Recheck that the build sheet sits 1049 mm above the floor.
6. Rotate the bubble level so it is running front-to-back. Adjust the feet accordingly until level in this axis. Recheck that the build sheet sits 1049 mm above the floor.
7. Double-check that the machine is still level left-to-right and adjust accordingly.
8. Use a wrench to lock the upper nut of the four inner feet to the chassis.
9. On the four outer feet, use a wrench to lower them until they just contact the floor, then lock the upper nut to the chassis.

4.4.3 Installing the build unit

After leveling, the build unit can be installed into the printer. Roll the build unit into the opening in the printer and push firmly until it is completely seated. If the printer is leveled correctly, the build unit will ramp in smoothly and its wheels will not be in contact with the floor when fully installed.

- If the printer is too high, the build unit will not be able to engage with the guide bearings to ramp it into place.
- If the printer is too low, the build unit will not be able to fully roll into place without interference.

4.4.4 Installing the vacuum conveyor

To install the vacuum conveyer onto the hopper:

1. Remove the vacuum conveyor from its packaging.
2. Using a ladder or stepstool, lift the vacuum conveyor to the top of the printer's hopper.

3. Place the outlet onto the corresponding flange.
4. Fasten the split clamp to ensure a tight fit. Tighten the screw if needed.
5. Connect the vacuum conveyor to power using the included socket.
6. Connect the vacuum conveyor to a compressed air source. Formlabs recommends an air source capable of delivering at least 10 SCFM at 100 psi. The same supply feeding the nitrogen generator may be used for this purpose. The vacuum conveyor on the powder mixer may be daisy-chained into the same line for convenience.

4.4.5 Powering on the machine

To turn on the printer:

1. Plug the newly-wired power cable into its outlet.
2. Turn the breaker switch on the back of the unit to the ON position to turn on the machine.
3. As the machine initiates, the Formlabs logo with a progress bar appears on the touchscreen.

4.5 Connecting the nitrogen supply

The Fuse X1 requires a supply of compressed nitrogen gas. Formlabs recommends using a nitrogen generator, which takes in power and compressed air and outputs nitrogen to the printer and oxygen to the environment. The nitrogen intake requirements are:

- Concentration: 99.5% or greater
- Nitrogen line fittings: ⅜ NPT (printer-side connector)
- Pressure: >50 PSI (regulated to 50PSI in printer)
- Continuous flow rate: 0.8 SCFM (22.65 L/min) minimum, 1.0 SCFM recommended
- Gas temperature at machine inlet: 18 °C or greater

Additionally, the vacuum conveyor for filling the printer with powder requires compressed air. Formlabs recommends using the same compressed air supply for both, running one branch to the nitrogen generator and the other to the vacuum conveyor.

If using a portable air compressor rather than a shop air system, power must be supplied.

4.5.1 Connecting a nitrogen source and adjusting nitrogen flow to the printer

With the nitrogen generator set up, the flow into the printer is set with a manual rotameter.

To adjust the nitrogen flow:

1. Using an 8 mm hex driver, unlatch and open the air handling access door, on the right side of the printer.
2. Locate the rotameter, on the right side of the air handling cabinet. Ensure the rotameter is closed initially by turning the knob clockwise to tighten.
3. Connect the outlet of the nitrogen generator to the inlet at the back of the printer using either the provided quick disconnect fitting or a suitable alternative.

4. Loosen the rotameter knob, turning counterclockwise, until the float reaches 48 SCFH (equivalent to 0.8 SCFM).
5. Close the air handling access door. Latch it shut using an 8 mm hex driver.

4.6 Setting up a network connection

For detailed guidance and visual assistance, visit **support.formlabs.com**.

Connect the Fuse X1 to a secure network via Ethernet or Wi-Fi (with a dongle), providing it internet access for remote printing, remote troubleshooting, sending diagnostic logs, and receiving firmware updates. The Fuse X1 can connect directly to a computer with a USB cable.

For remote printing and monitoring, the Fuse X1 supports both wired (Ethernet) and wireless (Wi-Fi) connections. Connect PreForm print preparation software to the same local-area network (LAN) as the printer in order to send a print job.

When the Fuse X1 is connected to a LAN, its current status and print progress can be monitored with Dashboard: **formlabs.com/dashboard**.

4.6.1 Connecting with Ethernet

The rear of the unit is equipped with a RJ-45 Ethernet (10BASE-T/100BASE-TX) 100 Mbit LAN Port. Use a shielded Ethernet cable (not included), minimum Cat5.

To connect with Ethernet:

1. Plug one end of the Ethernet cable into the Ethernet port on the back of the unit.
2. Connect the other end of the Ethernet cable to your LAN.

4.6.1.1 Connecting with a manual IP configuration

When connected to an active Ethernet connection, the Fuse X1 can be configured with a static IP address. Use the touchscreen to configure a manual IP connection.

To connect with Ethernet using a manual IP configuration:

1. With an established Ethernet connection, tap the gear icon on the **Home** screen. The **Settings** screen appears.
2. Tap **Connectivity**. The Connectivity screen appears.
3. For Ethernet connections, tap **Ethernet**. The **Manual IP Settings** screen appears.
4. Toggle Use **Manual IP** to **ON**. The toggle turns blue.
5. Enter the appropriate **IP Address, Subnet Mask, Default Gateway,** and **Name Server**.

4.6.2 Connecting with Wi-Fi

The Fuse X1 can connect to a Wi-Fi network via a Wi-Fi dongle plugged into the USB A port on the rear of the machine. For best performance, Formlabs recommends connecting via Ethernet or USB.

4.7 Updating firmware

Formlabs regularly releases updated firmware to fix bugs and improve functionality. Download the latest firmware version for your Formlabs device with PreForm, then upload and install the firmware file on the machine. Review the firmware downloads and release notes to learn more about the improvements that come with each version's release.

To update the firmware via PreForm:

1. Open PreForm.
2. Connect the machine to the computer via the USB B port on the rear of the machine or connect the device to an Ethernet or Wi-Fi network.
3. Click the **Edit Job Setup** card in the right-hand panel. The **Job Setup** window appears.
4. Select your Fuse X1 printer. If necessary, use the dropdown filter or search bar to narrow the list of available machines.
5. Click **Update Firmware**.
6. Follow the on-screen instructions to download the latest firmware and then upload the file to the machine. To upload firmware, the device must be connected to the computer via USB or the machine must be connected to an Ethernet or Wi-Fi network.
7. The machine may automatically recognize that you have sent a firmware update. Tap **Continue** on the touchscreen to finish the installation.
8. If you are not prompted to **Continue**, continue the firmware update manually. Tap **Settings > System > Firmware Update**.
9. After the firmware update installs, confirm the system restart on the touchscreen or wait 30 seconds for an automatic restart.

4.8 Registering powder credit

Each package of Formlabs powder includes an ID card. This card contains powder credits which must be loaded onto the printer to authorize and track the amount of powder that is available. Credit is subtracted from the available balance based on the amount of powder that is sintered. Powder that is unsintered can be recaptured by the Fuse Sift X1 for future use and is not deducted from the credit balance

4.8.1 Loading powder credit

Powder credit is used to identify which Formlabs powder you are using, as well as the amount of new powder that is available for printing. Before starting a print, load powder credits onto the printer.

To load powder credit:

1. Locate the card holder below the touchscreen.
2. Insert an unused powder identification card into the card holder. The Powder Credit screen appears on the touchscreen. The Powder Credit screen displays the amount of available powder credit on the new card and the amount of powder credit currently registered to the printer appears.
3. Tap Transfer to register the credit from the identification card onto the printer. The dialog box updates to show the new powder credit totals.
4. After loading the powder credit onto the printer, tap Done on the touchscreen. Remove the card from the card holder.

4.8.2 Checking available powder credit

When not loading or unloading powder credit onto the printer, you can check how much credit is available. This information can be found under settings.

To check available powder credit:

1. Tap the printer icon in the left sidebar on the touchscreen. The **Printer Status** screen appears.
2. All available powder credit for the printer is listed under the **Powder Credit** heading in the **Hopper** section.

3. Tap the > icon next to **Powder Credit**. The **Powder Credit** screen appears. The **Powder Credit** screen shows additional information about powder credits and instructions for loading powder credits.
4. Tap **Done** to close the **Powder Credit** screen.

4.8.3 Powder credit notifications

The printer reminds you of low powder credit over time, indicating that you may only have enough powder on hand for several more prints. Upon starting a print, the printer warns you if your credit is low.

- If the printer does not have sufficient powder credits for the current print job, the printer notifies you and does not start the print job. Load additional powder credit onto the printer and restart the print job.
- After a print completes, the printer notifies you if your powder credit total is low. Check the **Printer Status** screen to confirm there is enough powder credit registered to the printer to complete your upcoming prints. If not, you will be unable to start the next print until sufficient powder credits are registered to the printer. Register additional powder credits or order additional powder.

4.9 Filling the powder hopper

The vacuum conveyor on the Fuse X1 conveys powder into the printer hopper pneumatically.

1. Connect the vacuum conveyor inlet hose to the outlet at the base of the Mix Kit.
2. Start the vacuum conveyor using the control panel on the system.
3. Allow powder to fill the Fuse X1 hopper.
4. Turn off the vacuum conveyor when the hopper is adequately full for your print or when the Mix Kit is empty.

4.10 Filling the powder hopper

Alconox is a powder and must be mixed with distilled water in order to be an effective detergent for cleaning components within the printer.

NOTICE

Only mix Alconox powder with distilled water. Contaminants from water that is not distilled will collect on optical surfaces, adversely affecting print quality and the operating life of optical components. Do not clean any optical components with Alconox that has been mixed with tap, bottled, filtered, or any other source of water that is not distilled.

To mix Alconox:

1. Label one of the included push-top dispensers **Alconox**.
2. Unscrew the top of the dispenser and add 2.0 g (0.07 oz) of Alconox powder, followed by 200.0 mL (6.76 fl oz) of distilled water.
   - Each bottle's total volume is 200 mL (6.76 fl oz).
3. Screw the cap back on. Ensure it is locked by twisting the cap counterclockwise until you hear a subtle click.
4. Gently agitate the dispenser until the Alconox powder is completely dissolved. Avoid generating bubbles or foam from rapid shaking.

4.11 Transporting the machine

The Fuse X1 must be crated and palletized to be transported safely. Contact Formlabs Support for more information.

5 Printing

Use appropriate personal protective equipment when handling loose or unsintered powder. Wear non-reactive nitrile gloves and safety glasses. Wear a respirator (N95 or better) if the occupational threshold limit value for airborne particle concentration has been exceeded, if you are sensitive to dust or pollen, or you are concerned about your respiratory health. Refer to the safety data sheet for your selected information for more information. Handle loose or unsintered powder only with adequate ventilation. Avoid breathing mist/vapor/spray/dust. Do not eat, drink, smoke, or use personal products when handling powder. Avoid contact with skin, eyes and clothing.

5.1 Operational environment

The operating temperature for the Fuse X1 is 18–28 °C (68–82 °F), with ≤ 30% ambient humidity. For optimal printing, do not exceed these limits.

5.2 Designing for SLS

For detailed guidance and visual assistance, visit **support.formlabs.com**.

Selective Laser Sintering (SLS) enables the construction of parts without the use of support structures often required with SLA or FDM printing platforms. This allows parts to be tightly packed into a single print job, however there are some limitations that must be taken into account.

Sintered powder is sensitive to sudden and drastic temperature changes. Allow the build chamber to steadily and fully cool down after a print completes. Parts that are not allowed to properly cool down will warp, and can become brittle and fail under load.

5.2.1 Printing specifications

Parameter	Unit
Build volume (W × D × H)	330 × 330 × 565 mm (with 15 mm radiused corners) 13.0 × 13.0 × 22.2 in (with 0.59 in radiused corners)
Maximum singular part dimension	713 mm | 28.1 in
Layer thickness	110 µm | 0.0043 in
Preheat time	Approximately 60 min

5.2.2 Feature design guidelines

Feature type	Minimum value	Notes
Unsupported wall thickness	0.6 mm/600 µm	An unsupported wall is one that is connected to other walls on fewer than two sides. An unsupported wall with a thickness of 0.6 mm or less may warp or detach from the model during printing. Thinner walls have reduced strength.
Pin diameter	0.8 mm/800 µm	A wire is a feature whose length is at least two times greater than its width. Wires or pins with a diameter less than 0.8 mm width may deform or break during the print. Take extra care when separating printed parts with thin wires from the powder cake, as they can easily be damaged.
Hole diameter	0.8 mm/800 µm	Holes with a diameter of less than 0.8 mm in the X-, Y-, and Z-axes may close during printing. The accuracy of a hole not only depends on the diameter of the hole, but also on the thickness of the wall through which the hole is printed. The thicker the wall section, the less accurate the hole will be. Through holes must also allow for line-of-sight clearance to ensure all material is cleared during post-processing.
Moving part clearance	0.4 mm/400 µm	Clearance is the distance between two parts of a model (e.g., the distance between a pair of gears). Parts that are part of an assembly may fuse if clearance is less than 0.4 mm.

5.3 Setting up a print

For detailed guidance and visual assistance, visit **support.formlabs.com**.

Fuse X1 print jobs can be set up using PreForm, the dedicated print preparation software for Formlabs printers. To start, open OBJ, STL, or other 3D modeling files in PreForm, orient and layout multiple models into a complete build, then send the print job to the machine.

5.3.1 Downloading or updating PreForm

Visit the PreForm product webpage to download the latest version: **formlabs.com/software**. Learn how to use PreForm from the tutorials available in the software. Click **Help** > **Show Onboarding Tutorial** from PreForm's menu bar.

5.3.2 Preparing the file for printing

Use PreForm software to process 3D modeling files. Prepare, save, and upload FORM files to the printer.

5.3.2.1 Choosing job settings

To select the printer, material, and job settings for your print:

1. Open PreForm.
2. Click the **Edit Job Setup** card in the right-hand panel. The **Job Setup** window appears.
3. Select your Fuse X1 printer. If necessary, use the dropdown filter or search bar to narrow the list of available machines.
4. Select the material you will be printing with.
5. Select the print settings for that material, if multiple are available.
6. Click **Apply**. The **Job Setup** window closes and PreForm returns to the 3D scene.

5.3.2.2 Adding a model

Import multiple part files into PreForm to print multiple parts in a single build chamber.

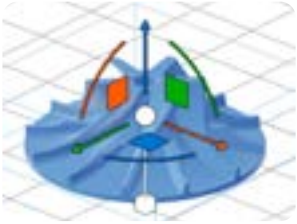
To add a model:

1. In the menu bar, click File > Open. The Open File window opens.

2. Select at least one file.
3. Click Open. The selected models appear in PreForm.

5.3.2.3 Orienting a model

The unsintered powder in the build chamber inherently supports parts, regardless of their orientation. However, depending on the geometry of the parts being printed, certain part orientations may minimize the visibility of print layers or to pack parts more densely into a complete print job.



To orient a model:

1. Select the model using the left mouse button. Manipulators appear over the model.
2. To rotate the entire mode around a single axis, click-and-drag along a curved, colored line.
3. To freely rotate a model, click-and-drag the central sphere.
4. To move the model along a single axis, click-and-drag on an individual arrow.

- To move the model up or down along the Z-axis within the build volume, click-and-drag on the blue arrow.
- To move the model left or right along the X-axis within the build volume, click-and-drag on the orange arrow.
- To move the model forward or back along the Y-axis within the build volume, click-and-drag on the green arrow.

5. To adjust the scale of the model, click-and-drag the cube below the manipulator.
6. Alternately, you can enter specific angles using the Orientation tool.

5.3.2.4 Uploading a print

After orienting your model(s) and saving your FORM file, upload your print job to the printer. Both the printer and the computer running PreForm must be connected via USB or on the same network in order to upload a print job. Refer to section **4.6 Setting up a network connection** for more information.

Once transferred, print jobs must be confirmed on the touchscreen to begin. Refer to section **5.4 Starting a print** for more information.

To upload a print job from PreForm to the machine:

1. By default, the job is named after the model files that have been added to it. If desired, update the job name at the top of the 3D scene.
2. If you have not already, log into your Dashboard account by clicking **Account > Log In** at the top-right corner of the screen.
3. Click **Upload to Queue** to send the print job to the printer. Once the progress bar fills, the upload is complete.

5.4 Starting a print

To start a print:

1. If the powder hopper does not already contain enough powder for your print, use the printer's vacuum conveyor to fill the printer hopper, as described in **4.9 Filling the powder hopper.**

2. Upload a print job to the machine.
3. Insert a clean build unit.
4. Make sure you have completed any due or past due maintenance procedures, as indicated on the touchscreen or in **6 Maintenance**.
5. Tap the **Queue** icon on the printer's touchscreen, locate your uploaded print job, and tap the play icon to start it.

5.5 Retrieving and cleaning prints with the Fuse Sift X1

After your print finishes and the build unit and powder cake cool, use the Fuse Sift X1 to retrieve your parts and recover the used but unsintered powder. For more information, see the Fuse Sift X1 manual or visit **support.formlabs.com**.

To retrieve your printed parts using the Fuse Sift X1:

1. Insert the build unit into the Fuse Sift X1 and ensure it is secured.
2. Close the Fuse Sift X1 hood and lock the hood latches.
3. Place a container to transport parts on the sifter access panel, next to the part transfer door.
4. If you have not done so already, connect the inlet hose from the Mix Kit vacuum conveyor to the outlet on the right side of the machine, below the sifter access panel.
5. Use the build unit controls inside the Fuse Sift X1 workspace to raise the powder cake out of the build unit. Press the up arrow once to fully raise it, or press and hold to jog the print bed upwards a specific amount.
6. Press the **Vac** button on the control panel to start the vacuum. This vents any pluming and improves visibility.
7. Insert your hands into the left and center gloves in the glovebox.
8. Manually break apart the powder cake. Push as much powder as possible over the grate on the right side of the workspace to allow powder to drop into the hopper below.
9. Press the **Sift** button on the control panel to a) start conveying powder from the hopper to the sifter and b) sifting the powder.
    a. If the vacuum conveyor is not connected to the outlet below the sifter, powder may spill or the sifter may stop. Press the **Sift** button again to stop the sifter and place an empty container in the receptacle, as described above.
10. Continue breaking out parts from the powder cake. Move your hands to the center and right gloves as needed to manipulate parts of the powder cake or use the built-in compressed air nozzle.
11. Pass extracted parts through the part transfer door into your transfer container. Continue until all parts are complete.
12. Move your printed parts to the Fuse Blast to finish cleaning them. For more information, see the Fuse Blast manual or visit **support.formlabs.com.**

5.6 Mixing and refreshing powder

After recovering used powder using the Fuse Sift X1, use the Mix Kit to mix used and fresh powder to the desired refresh rate. For reference, Nylon 12 Powder should be mixed in a ratio of 30% fresh powder to 70% used powder. For more information on recommended refresh rates, visit **support.formlabs.com**.

To mix powder using the Mix Kit:

1. Calculate the weight of used powder and fresh powder required for your desired refresh

rate and total amount of mixed powder.

2. Turn on and zero the Mix Kit scale.
3. Insert the Mix Kit vacuum conveyor inlet hose into your used powder container.
4. Turn on the Fuse Sift X1 and press the **Sift** button to activate the sifter.
5. Turn on the Mix Kit vacuum conveyor.
6. Fill the Mix Kit with used powder until it reaches the target weight.
7. Turn off the Fuse Sift X1 and the Mix Kit vacuum conveyor.
8. Insert the Mix Kit vacuum conveyor inlet hose into your fresh powder container.
9. Zero the Mix Kit scale.
10. Fill the Mix Kit with fresh powder until it reaches the target weight.
11. Turn off the Mix Kit vacuum conveyor.
12. Use the printer's vacuum conveyor to fill the printer hopper, as described in 4.9 **Filling the powder hopper**.

Note: Instead of using the vacuum conveyor to fill the Mix Kit with fresh powder, you can open the Mix Kit lid and pour powder from its container. If you are doing this, consider filling the Mix Kit with fresh powder first to reduce pluming.
Instead of moving the inlet hose from the used powder container to the fresh powder container, you can install a Y-valve on the Mix Kit vacuum conveyor inlet and use two separate tubes.

5.7 Managing the machine

For detailed guidance and visual assistance, visit **support.formlabs.com.**

During and between printing, you can track your printer's usage, manage print jobs, and prepare for future print jobs.

5.7.1 Accessing the serial name

The serial name is a unique identifier used to track the history of manufacturing, sales, and repair. The serial name is available on the printer's touchscreen in the top status bar.

To access the serial name the printer's touchscreen:

1. Tap the printer icon on the Home screen. The printer status screen appears.
2. The serial name is listed in the top-left corner.

5.7.2 Registering on Dashboard

Dashboard (**formlabs.com/dashboard**) allows individuals and teams to remotely monitor Formlabs devices, track material usage, and explore past and future Formlabs purchases. Register the Fuse X1 to Dashboard through the touchscreen. Once the printer is registered to Dashboard and **Dashboard Logging** is enabled on the printer, the Fuse X1 sends data to Dashboard as long as the printer's Wi-Fi or Ethernet connections are able to access the internet.

5.7.3 Deleting an uploaded print job

To delete an uploaded print job on the touchscreen:

1. Tap the print job from the **Queue**.
2. Tap **Delete**.

5.7.4 Turning off

The Fuse X1 is designed to remain powered on when not in use. Flip the breaker switch on the

back of the unit to the **OFF** position to turn off the machine completely and conserve power. When moving or storing the machine, unplug the unit from its power source in addition to flipping the breaker switch.

6 Maintenance

To maintain the most efficient and long-lasting machine, ensure regular conservation. Formlabs provides instructions to advise in installing, operating, and maintaining the machine. It shall only be maintained by a qualified and trained person. Unauthorized disassembly or repair procedures may damage the machine.

There are two groups of maintenance procedures: regular, which should be done after every print, and intermittent maintenance, which only needs to be done occasionally. Please keep a log detailing when each intermittent maintenance procedure was last performed. Prior to starting a print, the machine displays prompts on its touchscreen to notify the operator if any intermittent procedures are past due.

DANGER

Tampering with, or disassembling the Fuse X1 prior to disconnecting the power cable and waiting approximately ten minutes can subject users to potentially fatal electrical hazards.

WARNING

Wear personal protective equipment (PPE) when performing maintenance tasks. Use tools only as described.

CAUTION

When removing the exterior paneling, disconnect the machine from its power source before maintenance. Moving parts present crushing and tangling hazards.

NOTICE

- Formlabs provides instructions to advise skilled and unskilled persons in installing, operating, and maintaining the Fuse X1. The Fuse X1 shall only be maintained by a qualified and trained person.
- Do not open the Fuse X1 and/or investigate internal components unless under the guidance of Formlabs Support or a certified service provider. Contact Formlabs Support or a certified service provider for any additional guidance.
- Unauthorized disassembly or repair procedures may damage the machine and void the warranty.

6.1 Tools and supplies

Only use tools, chemicals, or procedures to maintain the Fuse X1 that are outlined in this manual, by prompts on the touchscreen, and on **support.formlabs.com**.

Do not use any tools, chemicals, or unapproved procedures with the Fuse X1 unless otherwise instructed to do so by Formlabs or a certified service provider.

The cleaning tools used to maintain the Fuse X1 are consumables, and intended for single-use only. Do not reuse a cleaning tool from one component with another.

- **Compliant vacuum that is grounded and bonded (e.g., Class II, Division 2 vacuum)**
  Certified for use with materials whose fine particles present an explosive risk when in the vicinity of potentially malfunctioning electrical equipment. Used to regularly remove loose powder from the workspace of the Fuse X1 and Sift X1.
- **Ethanol**
  Used for cleaning the printer's optical components.
- **Optical microfiber cleaning cloths**
  Disposable lint-free, non-woven microfiber cloths for cleaning the printer's optical components. Do not reuse an optical microfiber cleaning cloths; dispose of after each use, even when cleaning printer components with the same cleaning agent.
- **Polyester cloth swabs**
  Disposable lint-free polyester cloth swabs with either orange or blue plastic handles for cleaning the IR sensor and camera lens. Do not reuse a polyester swab—dispose of after each use.

6.2 Tasks between uses

Task	Frequency
Cleaning the build sheet and troughs	After a print has completed and sufficiently cooled to move the build unit
Cleaning the recoater roller	After a print has completed and sufficiently cooled to move the build unit

CAUTION

Do not use compressed air or an air gun to clean the print chamber, build unit, or any other component. Mobilizing loose powder increases the risk of unintentional inhalation or ingestion.
If a print was recently completed, the surfaces inside the print chamber will be hot. Take care while cleaning the build sheet, troughs, and recoater roller to avoid burns.

6.2.1 Cleaning the build sheet and troughs

1. Open the print chamber door.
2. Use a vacuum with a brush attachment to clean all visible powder and debris from the build sheet.
3. Tap **Maintenance > Motor Moves**. The **Motor Moves** menu appears. Use the UI buttons to move the flippers such that the inside of the troughs are accessible.
4. Use a vacuum with a crevice attachment to clean all powder and debris from within the troughs.

6.2.2 **Cleaning the recoater roller**

The recoater roller distributes powder across the print bed during the print. Any debris on the recoater roller could lead to a print failure.

To clean the recoater roller:

1. Open the print chamber door.
2. Tap **Maintenance > Motor Moves**. The **Motor Move** menu appears. Use the UI buttons to move the recoater roller to the middle of the print chamber.

3. Using a microfiber cloth wetted with Alconox, wipe the underside of the roller. Do not use shop wipes embedded with waxy additives because they can stick to the roller.
4. Use the controls on the **Motor Moves** screen to jog the recoater arm to the left or right so that the roller makes a 180 degree rotation.
5. Wipe the underside of the roller again.
6. Repeat steps 3–5 using a clean microfiber cloth wetted with distilled water to remove any Alconox residue.

6.3 Periodic maintenance

Sintering powder results in the production of off-gases and laurolactam, which collect on various components in the print chamber and air system. In order to preserve the accuracy and reliability of the product, it is important to regularly check and clean several components and assemblies. The Fuse X1 displays prompts on its touchscreen to notify if any periodic maintenance procedures are past due.

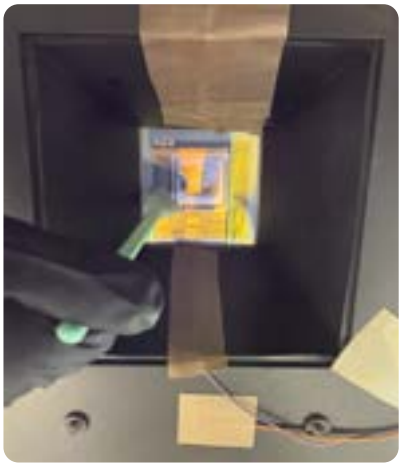
Task	Print Hours	Frequency
Cleaning the lower laser window	240	Every 2 weeks
Cleaning the IR sensor and purge housing	240	Every 2 weeks
Cleaning the camera window and purge housing	240	Every 2 weeks
Cleaning the exhaust filter	240	Every 2 weeks
Cleaning the purge filters	240	Every 2 weeks
Cleaning the print chamber exhaust tubing	480	Monthly
Cleaning the IR sensor purge tubing	480	Monthly

6.3.1 Cleaning the lower laser window

The lower laser window is one of the optical components between the laser source and the unsintered powder on the print bed. Contamination on the lower laser window can lead to print defects or failures.

To clean the lower laser window:

1. Open the print chamber door.
2. Use a telescoping mirror wand to locate the lower laser window. See **2.3 Product components** for more information.
3. Use a polyester swab wetted with Alconox to wipe the surface of the window.
4. Use a new polyester swab wetted with distilled water to wipe the surface of the window and remove any Alconox residue.
5. Use a new polyester swab wetted with ethanol to wipe the surface of the window. Allow the ethanol to evaporate before continuing to use the printer.



6.3.2 Cleaning the IR sensor and purge housing

1. Open the print chamber door.
2. Use a telescoping mirror wand to locate the inside of the IR sensor purge housing. See **2.3 Product components** for more information.
3. Use a polyester swab wetted with ethanol to wipe the inner surface of the purge housing.

4. Using an 8 mm hex driver, unlatch and open the maintenance access door, above the print chamber door.
5. Unlatch the IR sensor from the printer.
6. Remove the IR sensor and use a microfiber cloth wetted with ethanol to wipe the surface of the lens.

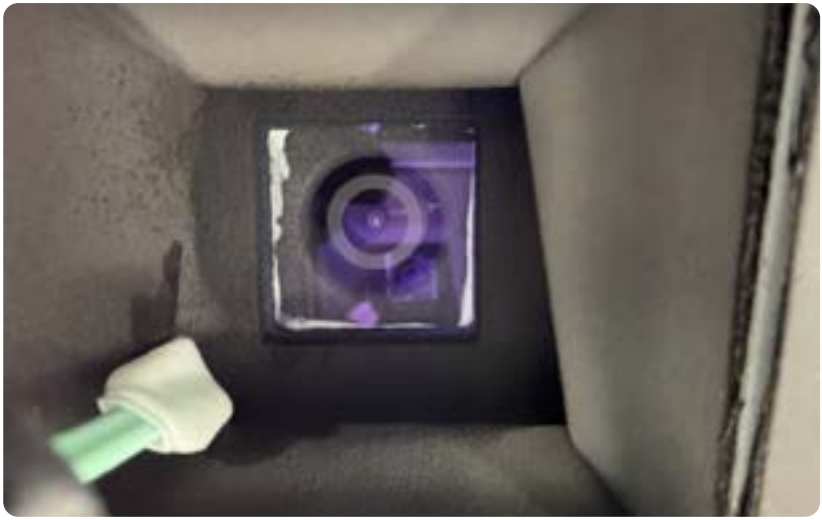
7. Place the IR sensor onto its mount and latch it in place.
8. Close the maintenance access door. Latch it shut using an 8 mm hex driver.

6.3.3 Cleaning the camera window and purge housing

The Fuse X1 uses a camera to monitor the status of the print. If the printer detects a defect in a part, it stops printing that specific part in order to safely and successfully complete the rest of the print job. Any contamination blocking the camera could lead to inaccurate print monitoring and print failures.

To clean the camera window and purge housing:

1. Open the print chamber door.
2. Use a telescoping mirror wand to locate the inside of the camera purge housing. See 2.3 Product components for more information.
3. Use a polyester swab wetted with ethanol to wipe the inner surface of the purge housing.



4. Using an 8 mm hex driver, unlatch and open the maintenance access door, above the print chamber door.
5. Unlatch the camera module from the printer.
6. Remove the camera and use a microfiber cloth wetted with ethanol to wipe the window.

7. Place the camera module on its mount and latch it in place.
8. Close the maintenance access door. Latch it shut using an 8 mm hex driver.

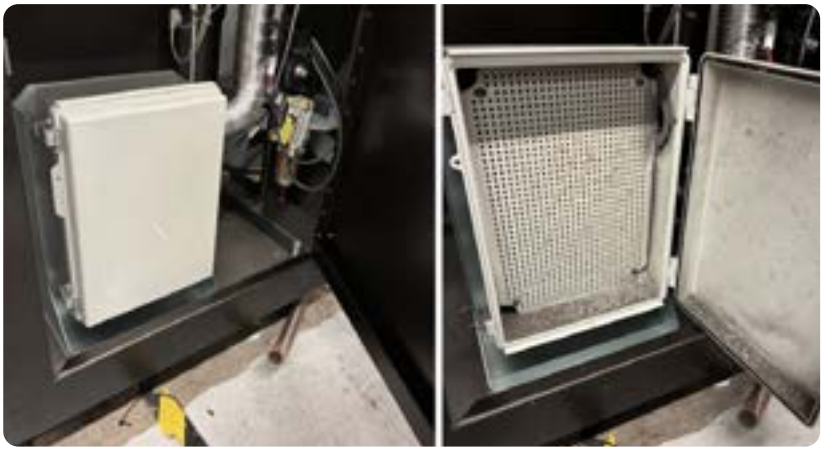
6.3.4 Cleaning the exhaust filter

The Fuse X1 filters its exhaust gases to remove any byproducts of powder sintering. A dirty exhaust filter is less effective and could cause your printer to display an error message.

To clean the exhaust filter:

1. Using an 8 mm hex driver, unlatch and open the air handling access door, on the right side of the printer.

2. Unlatch and open the exhaust filter box.



3. Use a vacuum with a brush attachment to clean the face of the filter cover.

4. Close and latch the exhaust filter box.
5. Close the air handling access door. Latch it shut using an 8 mm hex driver

6.3.5 **Cleaning the purge filters**

The Fuse X1 purges the region in front of the IR sensor and camera windows to keep them free of contamination and reduce the frequency at which you need to clean them. As part of that, the printer filters the purge gas. Dirty purge filters are less effective and could cause your printer to display an error message.

To clean the IR sensor or camera purge filter:

1. Using an 8 mm hex driver, unlatch and open the maintenance access door, above the print chamber door.
2. Unlatch and open the IR sensor or camera purge filter box.

3. Twist and pull downward to remove the cone filter.

4. Use a vacuum with a brush attachment to clean the pleats of the filter and the inside of the filter box.

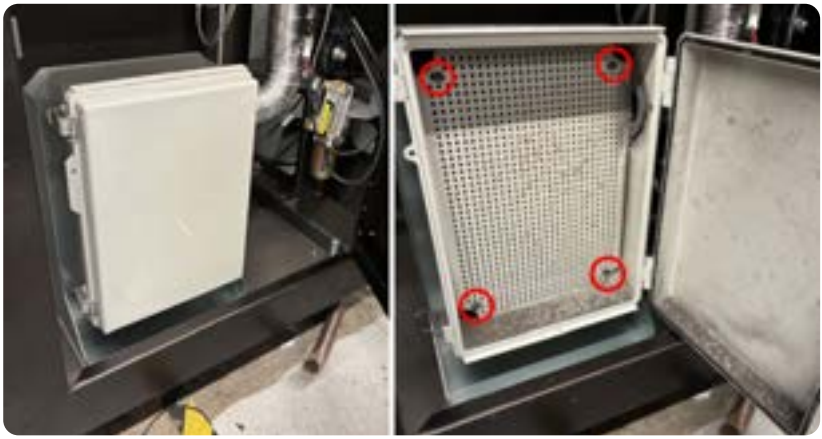
5. Reinstall the filter.
6. Close and latch the filter box.
7. Close the maintenance access door. Latch it shut using an 8 mm hex driver.

6.3.6 **Cleaning the print chamber exhaust tubing**

Contamination in the print chamber exhaust tubing can prevent the printer from maintaining the target pressure inside the print chamber.

To clean the print chamber exhaust tubing:

1. Using an 8 mm hex driver, unlatch and open the air handling access door, on the right side of the printer.
2. Unlatch and open the exhaust filter box.
3. Using a 4 mm hex driver, loosen and remove the four screws securing the filter cover. Set the screws and cover aside.



4. Remove the exhaust filter and set it aside.

5. Turn on your vacuum and hold the inlet to the exhaust tube for at least 30 seconds.

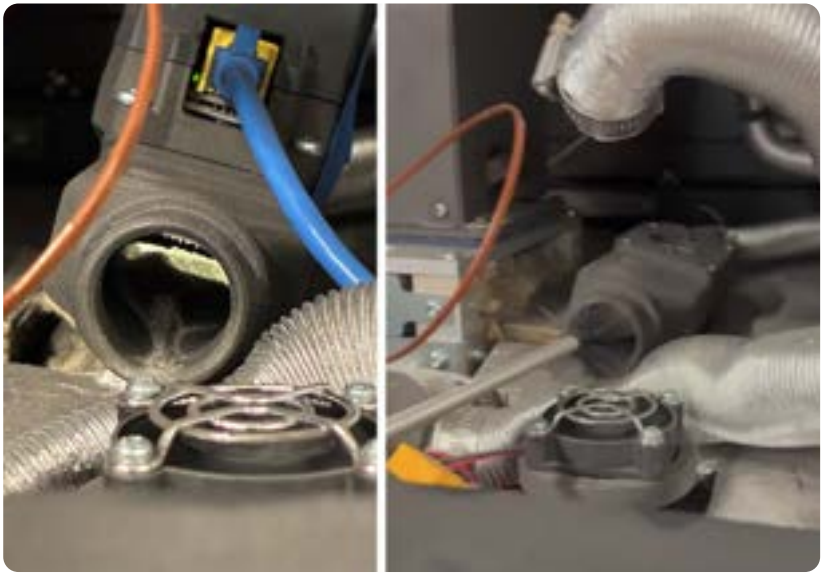
6. Turn off the vacuum.
7. Reinstall the exhaust filter.
8. Reinstall the filter cover, aligning the four screw holes in the filter with the corresponding screw holes in its mount. Thread one mounting screw into each of the four screw holes. Using a 4 mm hex driver, tighten until snug.
9. Close and latch the filter box.
10. Close the air handling access door. Latch it shut using an 8 mm hex driver.

6.3.7 Cleaning the IR sensor purge tubing

The Fuse X1 purges the region in front of the IR sensor and camera windows to keep them free of contamination and reduce the frequency at which you need to clean them. Over time, contaminants can build up in the tubing that connects to the IR sensor purge housing, reducing the efficacy of the purge and allowing the IR sensor to become dirty.

To clean the IR sensor purge tubing:

1. Access the IR sensor purge housing. For detailed steps, see **6.3.2 Cleaning the IR sensor and purge housing**.
2. Loosen the hose clamp securing the outlet tube to the IR sensor purge.
3. Use the included pipe cleaning brush to clear out any buildup from inside the purge housing.
4. Repeat this process on the tube itself, pushing the brush all the way to the filter box.



5. Reconnect the outlet tube to the IR sensor purge housing and secure it with the hose clamp.
6. Close the maintenance access door. Latch it shut using an 8 mm hex driver.

6.4 Intermittent maintenance

Task	Frequency
Updating the firmware	When PreForm indicates a new firmware version is available.
Replacing the exhaust filter	Biannually
Replacing the purge filters	Biannually
Cleaning the gas intake filter	Biannually
Cleaning the build chamber felt seal	If there is visible melted powder protruding from the felt seal, or if the Z-axis stalls intermittently, triggering a print error.
Replacing the recoater arm and roller	If there is visible damage or buildup on the roller surface that cannot be removed by cleaning.
Replacing the quartz tube heaters	If one or more lamps fails to turn on, triggering a print error.

6.4.1 Updating the firmware

For detailed guidance and visual assistance, visit **support.formlabs.com**.

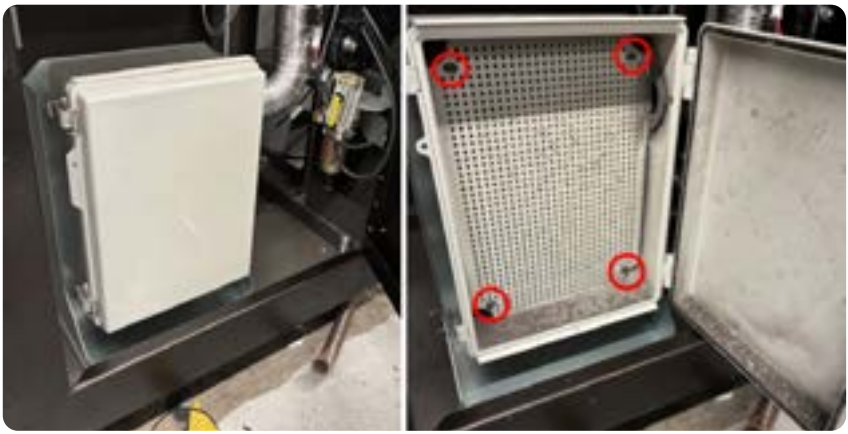
Formlabs regularly releases updated firmware to fix bugs and improve functionality. Review the PreForm and firmware release notes to learn more about the improvements that come with each version's release.

See **4.7 Updating firmware** for more information.

6.4.2 Replacing the exhaust filter

When disposing of a damaged or clogged exhaust filter, remove it from the printer and clean off any laurolactam and powder. Once cleaned, the filter can be disposed of with standard waste.

1. Using an 8 mm hex driver, unlatch and open the air handling access door, on the right side of the printer.
2. Unlatch and open the exhaust filter box.
3. Using a 4 mm hex driver, loosen and remove the four screws securing the filter cover. Set the screws and cover aside.



4. Remove the exhaust filter and set it aside for disposal.

5. Install the new exhaust filter.
6. Mount the exhaust filter cover, aligning the four screw holes in the filter with the corresponding screw holes in its mount. Thread one mounting screw into each of the four screw holes. Using a 4 mm hex driver, tighten until snug.
7. Close and latch the filter box.
8. Close the air handling access door. Latch it shut using an 8 mm hex driver.

6.4.3 Replacing the purge filters

When disposing of a damaged or clogged purge filter, remove it from the printer and clean off any laurolactam and powder following the instructions in section **6.3.5 Cleaning the purge filters**. Once cleaned, the filter can be disposed of with standard waste.

6.4.4 Cleaning the gas intake filter

Any contaminants from the compressed gas supply are caught by the gas intake filter. Depending on whether there is any filtration upstream of the printer, this filter may clog periodically or never at all.

To clean the gas intake filter:

1. Disconnect the gas supply from the printer.
2. Using an 8 mm hex driver, unlatch and open the air handling access door, on the right side of the printer.

3. Locate the gas intake filter, on the right side of the air handling cabinet.

4. Push the slider downwards, twist, and pull to remove the bowl from the rest of the filter.

5. Dump any moisture accumulated in the bowl. Rinse the bowl with water if needed.
6. Use a paper towel or cloth to wipe contaminants from the surface of the foam filter.
7. Reinstall the bowl, ensuring it locks into place.
8. Close the air handling access door. Latch it shut using an 8 mm hex driver.
9. Reconnect the gas supply to the printer.

6.4.5 Cleaning the build unit felt seal

The build unit has a felt seal around the edge of the print bed that prevents powder from leaking into the body of the build unit. If the felt seal is dirty or contaminated, the print bed may not move smoothly, or the contamination may melt during a print.

To clean the build unit felt seal:

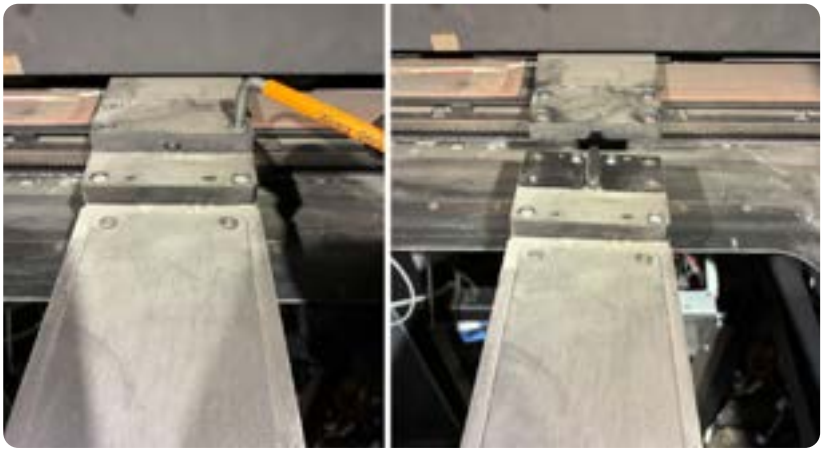
1. Empty the build unit using a Fuse Sift X1. Make sure the print bed is at its top position.
2. Vacuum any powder on the top of the build unit.
3. Using a T20 Torx driver, loosen and remove the four screws securing the print bed to the build unit. Set the screws aside.
4. Use a prying tool to pry the print bed upwards until where it can be removed by hand.
5. Use a vacuum with a brush attachment to clean all powder and debris from the felt seal around the edge of the print bed.
6. Reinsert the print bed into the build unit, aligning the screw holes in the print bed with the corresponding ones in the build unit itself. Thread one print bed mounting screw into each of the four screw holes. Using a T20 Torx driver, tighten until snug.

6.4.6 Replacing the recoater arm and roller

The recoater may encounter damage such as scratches and wear after normal use that cannot be resolved by cleaning.

To replace the recoater arm and roller:

1. Open the print chamber door.
2. Tap **Maintenance > Motor Moves**. The **Motor Moves** menu appears. Use the UI buttons to move the recoater roller to the middle of the print chamber.
3. Using a 5 mm hex driver, loosen and remove the four screws securing the recoater arm.
4. Pull the arm and roller assembly forward until it releases from the printer.



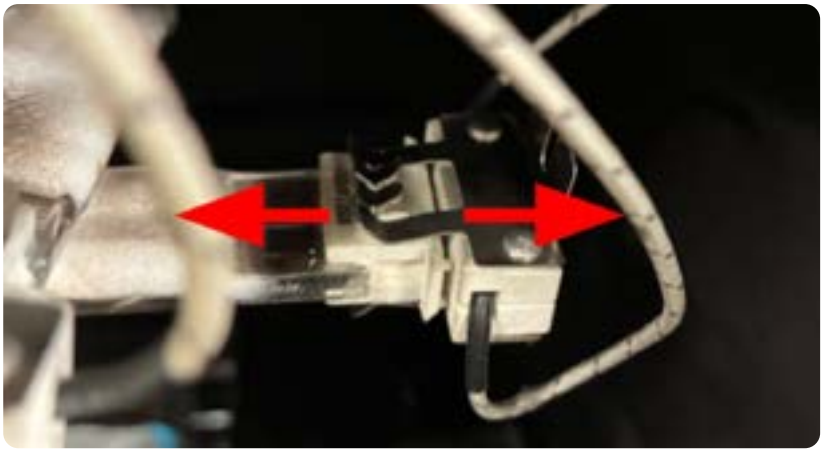
5. Slide the replacement recoater arm and roller into place, aligning the four screw holes in the arm with the corresponding screw holes in its mount.
6. Thread one recoater mounting screw into each of the four screw holes. Using a 5 mm hex driver, tighten until snug.

6.4.7 Replacing the quartz tube heaters

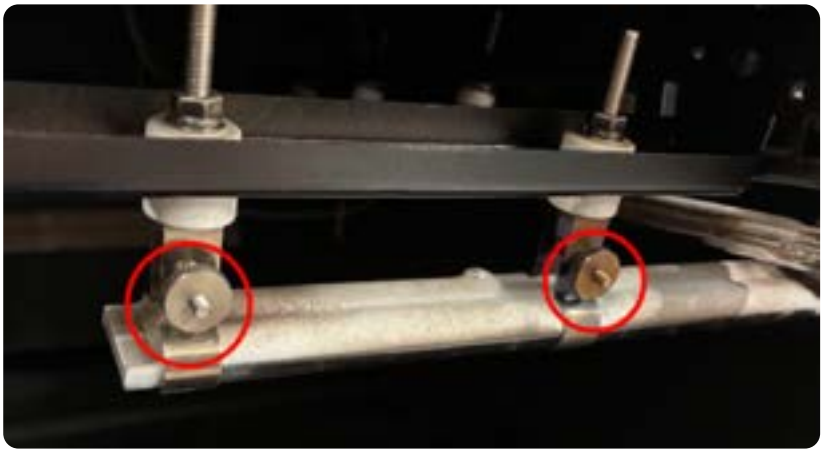
The Fuse X1 uses eight quartz tube heaters to evenly heat the print chamber during the print. If any of these heaters are faulty, the printer may have difficulty reaching or maintaining its target temperature, leading to print failures.

To replace a quartz heater tube:

1. If the printer was recently in use, wait for it to cool completely to room temperature before proceeding.
2. Open the print chamber door.
3. Locate the faulty heater.
4. Firmly pull the heater out of its socket.



5. Loosen the clamps securing the heater bulb in place and remove the heater.



6. Put on a clean pair of nitrile gloves before handling the replacement heater. Skin oils can damage the quartz glass once the heater is powered on.
7. Install the replacement heater by pressing firmly into the socket until it clicks into place. Ensure the white coating on the glass is facing upward.
8. Secure any clamps that were loosened previously.
9. Dispose of the faulty heater in accordance with local regulations for halogen lightbulbs.

7 Troubleshooting

For detailed guidance and visual assistance, visit **support.formlabs.com**.

7.1 Collecting diagnostic logs

The Fuse X1 maintains diagnostic logs to provide detailed information about the machine that may expedite issue investigation. After experiencing any error or unusual behavior on the Fuse X1, include the diagnostic logs with other relevant observations and details when contacting Formlabs Support or a certified service provider. The options for sharing diagnostic logs vary depending on the machine's connection type.

7.2 Performing a factory reset

NOTICE

Do not perform a factory reset immediately before contacting **Formlabs Support** or a **certified service provider**. The stored diagnostic information may be helpful to **Formlabs Support** or a **certified service provider** to assist with troubleshooting. A factory reset erases diagnostic information and custom settings, including uploaded jobs and networked connections.

7.3 Troubleshooting errors or abnormal activity

In the case of errors, abnormal activity, or print failures with the Fuse X1, reference the following errors, causes, and proposed solutions. Complete the initial troubleshooting steps and carefully document all results. Contact Formlabs Support or a certified service provider for additional guidance. Provide diagnostic logs if requested.

7.3.1 Resolving abnormal functions

Error	Cause	Solution
Unresponsive machine The Fuse X1 does not turn on.	• The power cable is disconnected • The breaker switch on the machine is set to **OFF**	1. Check whether the circuit has power, and that the power cable is securely connected to the outlet. 2. Turn off the machine by flipping the breaker switch on the back of the unit to **OFF**. 3. Leave the machine off for at least one minute. 4. Turn on the machine by flipping the breaker switch to **ON**. 5. Start a new print. If the machine is still unresponsive after restarting, contact Formlabs Support or a certified service provider for additional guidance.

Error	Cause	Solution
Unresponsive touchscreen Buttons or controls on the touchscreen do not respond to touch input.	• One-off firmware glitch • Loose connection with the touchscreen	1. Power cycle the machine by flipping the breaker switch on the back of the unit to **OFF** and back to **ON**. 2. Check whether the machine is running the latest firmware and update the firmware if needed. If the touchscreen repeatedly stops responding after trying these steps, contact **Formlabs Support** or a **certified service provider** for additional guidance.

7.3.2 Resolving print failures and errors

Print failures can manifest in different ways and originate from different causes. Check the model's configuration in PreForm, the cleanliness of the optical surfaces, and the printer's operating condition according to section **6 Maintenance** as well as the proposed solutions below.

If print failures persist after following these steps, contact Formlabs Support or a certified service provider for additional guidance. Provide clear, focused photographs of the test print to help diagnose the issue.

7.3.2.1 General print issues

Error	Cause	Solution
Hard cake • Unsintered powder fused into a stiff cake • Difficulty separating the part from the unsintered powder • Poor underlying surface finish and loss of small negative features	Bed temperature is too high.	Clean the IR sensor and purge housing.
Warping • Large scale curvature or a part or section of parts • Deviation from flatness	• Improper cooling procedure; warping can occur during a print if the part is allowed to cool non-uniformly or if the part is removed while still hot • Bed temperature is too high.	1. Wait for parts to cool to near room temperature prior to removal from the build unit. 2. Clean the IR sensor and purge housing.
Dimpling/Pitting • Surface imperfections on the top-most surface on parts, typically on small cross-sectional regions • In some cases, a hole that is deeper or several layers thick	Bed temperature is too high.	Clean the IR sensor and purge housing.
Melting The powder on the surface of the print is blackened due to melting.	Heaters heated the powder to above its melting temperature.	Clean the IR sensor and purge housing.

Error	Cause	Solution
Delamination A sintered layer failed to adhere to a previously sintered layer.	• Optical contamination or insufficient laser power	Inspect and clean the optical surfaces.
Fragile parts • Parts with excessively low strength • Parts occasionally have a lighter color and a more granular surface texture than normal	• Optical contamination or insufficient laser power	Inspect and clean the optical surfaces.
Poor surface finish (orange peel, birchbark) on vertical surfaces	• Optical contamination or insufficient laser power	Inspect and clean the optical surfaces.

8 Disassembly and repair

All steps that involve opening the machine and/or investigating internal components should be done by skilled persons under the guidance of Formlabs Support or a certified service provider. Any damage resulting from attempting disassembly and/or repair without prior authorization from Formlabs Support or a certified service provider is not covered by warranty.

For a list of user-replaceable parts, see Appendix I: Replacement parts and repair procedures. Any other maintenance or repair tasks not listed in section **6 Maintenance** requires servicing the machine. Replacement parts are available for purchase on the Formlabs Store. Your machine's warranty or service plan may entitle you to preventative maintenance or break-fix repair visits. For more information, contact Formlabs Support or a certified service provider.

9 Recycling and Disposal

9.1 Disposal of powder

9.1.1 Unsintered powder

Unsintered used SLS powder must be disposed of in accordance with applicable ordinances and environmental regulations for plastic waste. Particular caution must be taken with powdered plastic, as it is a microplastic and poses severe environmental repercussions..

Unsintered SLS powder is classified as a microplastic, a group of plastics that are hazardous to aquatic life. Do not dispose of unsintered used powder into drains or household waste streams. Safe and appropriate disposal methods of unsintered used powder vary by location. Consult the safety data sheet (SDS) from the powder supplier as the primary source of information to understand safe disposal of unsintered material.

9.1.2 Sintered powder or cleaned parts

Discard cleaned parts and sintered powder with household items as trash. Cleaned parts and sintered powder cannot be recycled.

9.2 Recycling of powder

9.2.1 Unsintered powder

Unsintered used SLS powder can be recaptured using the Fuse Sift X1 for use in future prints. The Fuse X1 can print with up to 80% recycled powder. For more information on recommended refresh rates, visit support.formlabs.com.

NOTICE

Formlabs does not operate a recycling program.

9.2.2 Sintered powder or cleaned parts

Discard cleaned parts and sintered powder with household items as trash. Cleaned parts and sintered powder cannot be recycled.

9.3 Disposal of cleaning agents

Safe and appropriate disposal methods of used solvent vary by location.

To safely dispose of used solvent:

1. Consult the safety data sheet (SDS) from the solvent supplier as the primary source of information.
2. Research the approved methods of disposal for your area. This will most likely involve hiring a waste disposal service. For smaller amounts, check with a hazardous disposal service to see if they have any suggestions for removal.
3. Inform your waste disposal service that your bottle contains solvent with small amounts of laurolactam and microplastics. Have a copy of the Formlabs powder safety data sheet (SDS) on hand in case the disposal service attendant needs more information.

9.4 Recycling of solvent

For large volumes of solvent, consider using a solvent recycling system, which offers a cost effective and more environmentally responsible alternative to paying for waste solvent disposal services. Solvent recycling systems use distillation and fractionation processes to remove solutes from waste solvents, making it possible to reuse the solvent. The recycled solvent may still have small amounts of contaminants in it. Recycling solvent reduces waste disposal costs, emissions that are required to produce solvents, and the cost of purchasing solvent.

9.5 Disposal of electronic components

The symbol on the product, the accessories, or packaging indicates that this device shall not be treated as nor disposed of with household waste. When you decide to dispose of this product, do so in accordance with environmental laws and guidelines. Dispose of the device via a collection point for the recycling of waste of electrical and electronic equipment. By disposing of the device in the proper manner, you help avoid possible hazards for the environment and public health that could otherwise be caused by improper treatment of waste equipment. The recycling of materials contributes to the conservation of natural resources. Therefore do not dispose of your old electrical and electronic equipment with the unsorted municipal waste.

9.6 Disposal of packaging waste

Dispose of packaging through waste and recycling facilities. By disposing of the packaging waste in the proper manner, you help avoid possible hazards for the environment and public health.

NOTICE

The original packaging is designed to be kept and reused for transporting or shipping the machine for service. Save the complete packaging including any inserts for your convenience.

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11 Glossary

Term	Meaning
Alconox	A general purpose lab cleaning agent that is recommended for cleaning certain components within the printer.
Build unit	An interchangeable component of the Fuse X1 that contains the print bed (representing the Z-axis of 56.5 cm/22.2 in), heaters and temperature sensors, and encapsulates the sintered parts and loose powder from a print. The built-in plug allows the Fuse X1 and Fuse Sift X1 to monitor and control the build unit.
Build volume	The total cubic dimensions in which 3D models can be printed. The Fuse X1 has a build volume of 33.0 × 33.0 × 56.5 cm (13.0 × 13.0 × 22.2 in).
Cake	The final product of a print, containing both loose unsintered SLS powder and the printed parts.
Distilled water	Water that is free of impurities, and is the second agent used for wiping off residual alconox from the previous cleaning step.
Ethanol	A simple alcohol that is the recommended denaturing agent for removing deposits of laurolactam and other off-gassing stains from the printer's optics.
Flippers	Two paddles, one on the left and right side of the powder handling system, that move powder into position for the recoater roller to pick-up and deposit onto the print bed.
Galvanometer (galvo)	A high-speed precision motor that positions a mirror used for refl ecting the laser spot. The Fuse X1 uses two galvos to position the laser spot along the X and Y-axes of the print area.
Hopper	The fi xed container on the side of the Fuse X1 that holds powder for printing.
Interlock	A safety mechanism that automatically shuts off the laser and heaters if the print chamber door is open, the build unit is not properly inserted, or the E-stop is pressed.
Infrared (IR)	Electromagnetic radiation that extends from the nominal edge of the visible spectrum at 700 nanometers (nm) to 1 millimeter (mm).
IR sensor	An electronic device that monitors the temperature in the print chamber by measuring infrared radiation.
Laser	Short for "Light Amplifi cation" via "Stimulated Emission of Radiation." The laser is the source of sintering energy in the Fuse X1 with a wavelength of 1065 nm, and a maximum output of 120 W. The Fuse X1 is a Class 1 laser product.
Laurolactam	An organic compound used as a monomer to produce Nylon 12. It is also a byproduct of SLS nylon printing.
Layer	A thin individual planar section of an object being printed. The 3D object's geometry is sliced into a large number of 2D layers that are sequentially sintered together, forming the object.
Micron (µm)	An SI derived unit of length equalling 1×10−6 meter, or one millionth of a meter (or one thousandth of a millimeter, 0.001 mm, or about 0.000039 inch).

Term	Meaning
Nylon	An industrial thermoplastic that bends before returning to its original form without fracturing, making it suitable for structural, load bearing, or mechanical parts.
Optical microfiber cleaning cloths	Disposable lint-free, non-woven microfi ber cloths for cleaning the printer's optical components. Do not reuse an optical microfi ber cleaning cloths; dispose after each use, even when cleaning printer components with the same cleaning agent.
Orange peel	A type of print defect that occurs in SLS printing when the temperatures of a group of layers diff er from each other, causing some layers to shrink or curl inconsistently.
Personal protective equipment (PPE)	Garments or articles of clothing designed to protect individuals from physical, electrical, heat, chemicals, biohazards, and airborne particulate matter.
Plume	A localized emission of pulverized material.
Polyester cloth swab	A disposable lint-free polyester cloth swab with a plastic handle that is used for cleaning the printer's IR sensor and camera lens. Do not reuse a polyester cloth swab; dispose of after each use.
PreForm	Orient and lay out models in PreForm before sending them to the printer. PreForm uses advanced, proprietary calculations to optimize print settings for each model.
Print bed	An aluminum plate onto which printing powder is deposited in 110 micron layers and sintered to form 3D parts.
Print chamber	The main compartment inside the printer that contains the build chamber, camera and sensors, quartz heaters, and powder dispensing components.
Print Intelligence	A system incorporating a visible light camera, an IR camera, and artificial intelligence engine to monitor prints for potential issues, and stop printing a specific failing part if a significant issue is detected.
Quartz heater	A heating system consisting of a tungsten element sealed inside quartz tubes that emits infrared radiation.
Recoater roller	A bar that moves from left-to-right to pick up powder from either side of the upper print chamber, then deposits it as a layer on the print bed or the previous layer.
Selective Laser Sintering (SLS)	An additive manufacturing process that uses a high-powered laser to sinter uniform beads of plastic together, drawing out individual 2D layers (or slices) that eventually form a 3D part.
Surface armor	A print process component of the Fuse X1 that surrounds parts with a semi-sintered shell of material to alleviate thermal inconsistencies which may adversely aff ect the accuracy of a part.

12 Product compliance

The Fuse X1 complies with the following machinery, electromagnetic, waste, and laser safety standards:

Safety

- UL 2011
- CSA C22.2 No. 301
- EN 60204-1
- IEC 60825-1
- IEC 62368-1 Laser

Electromagnetic Compatibility (2014/30/EU)

- FCC 47CFR Part 15 Subpart B: 12/2025
- AS/NZS CISPR 32:2015
- CENELEC EN 55032:2015+A11
- ETSI EN 301 489-1:2019 Ed.2.2.3
- ETSI EN 301 489-3:2023 Ed.2.3.2

Appendix I: Replacement parts and repair procedures

Replacement parts are available for purchase on the Formlabs Store. For installation and repair guides, visit support.formlabs.com or contact Formlabs Support or a certified service provider.

Fuse X1

- Agitator
- Air intake filter
- Buffer flipper motor assembly
- Build unit connector
- Build unit interlock switches
- Camera module
- Camera purge filter box
- Chamber light assembly
- Chamber thermal cutoff
- Cooling air filter
- Display assembly
- Doser motor assembly
- Doser top edge seal
- Doser wheel
- Exhaust filter
- Exhaust filter box
- Exhaust tubing
- Flipper plate
- Galvo block assembly
- Gas heater assembly
- Gas intake assembly
- Heater board
- Hopper flipper motor assembly
- Hopper lights
- Hopper window
- IR and camera purge tubing
- IR purge fi lter box
- IR sensor module
- Laser and build unit relay
- Laser module
- Leveling foot
- Lower laser window
- Main switch and I/O assembly
- Mains breaker switch
- Mains contactor
- Mains surge protector
- Motherboard and System on Module (SOM)

- Motor driver
- Motor homing sensor assembly
- Powder sensor
- Power supply unit
- Print chamber door maintenance
- Printer wheel
- Quartz tube heater
- Quartz tube heater socket
- Recoater arm and roller
- Recoater maintenance
- Recoater motor assembly
- RTD temperature sensor
- Safety relay
- Trough and doser heater

Fuse X1 Build Unit

- Build unit connector
- Control board
- Handle
- Piston top heater
- Print bed assembly
- Top gasket
- Wall heater
- Wheels
- Z-axis motor assembly